Promoting the Integration of Digital Technologies to Strengthen the Educational Trajectories of Socioeconomically Vulnerable Populations in Latin America and the Caribbean

Presentation

Fundación Ceibal in Uruguay leads the project *Strengthening Local Capacities to Generate a Sustainable and Impactful Educational Digital Transformation in Latin America and the Caribbean (2025-2027)*, which is funded by the International Development Research Centre (IDRC) of Canada. One of the specific objectives of the project is to generate evidence on the current state of educational technology integration in the countries of the region.

Within this framework, **a first call will be launched to fund applied research projects aimed at promoting the integration of digital technologies to strengthen the educational trajectories of socioeconomically vulnerable populations in Latin America and the Caribbean (LAC).**

In response to the challenge of closing gaps in access to and use of digital technologies in the deeply unequal context of Latin America and the Caribbean, the focus is placed on the specific needs of children and adolescents living in poverty, promoting the development of studies, models, methodologies, and digital tools focused on:

- **School management systems**
- **Strategies to identify students at risk and ensure timely interventions**
- **Strengthening learning outcomes**
- **Design of comprehensive, context-based support mechanisms**
- **Use of Artificial Intelligence algorithms to support educational trajectories**
- **Provision of information to families to strengthen educational trajectories**

Inequality as a structural feature of Latin America and the Caribbean

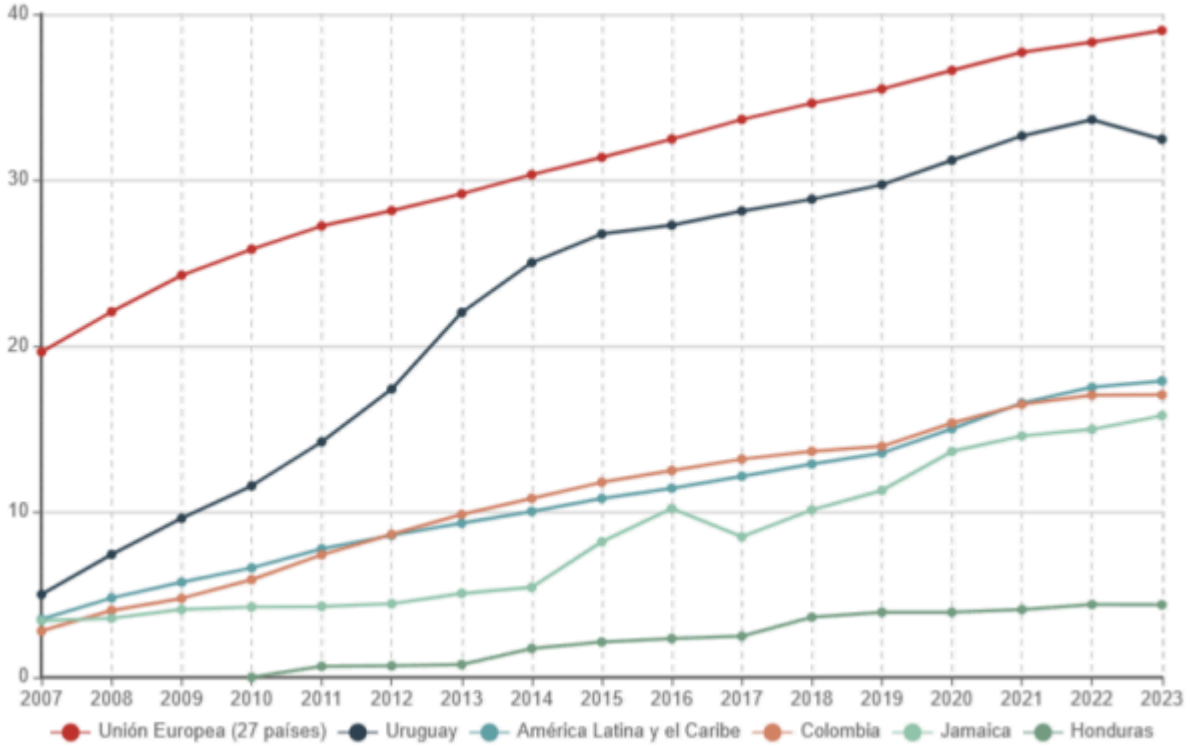
According to IDB data (2024) **Latin America and the Caribbean remains one of the most unequal regions in the world**. Focusing on income reported in household surveys, by 2020 the Gini coefficient in the region averaged around 0.5—with 0 representing perfect equality and 1 representing a scenario in which all income is concentrated in a single individual. This is a very high figure, which in practice could be even higher, considering that household surveys often overlook many of the wealthiest households (hence, research based on tax data suggests that the true value of this coefficient would be significantly higher). Naturally, regional averages conceal the substantial heterogeneity within LAC: for instance, it can be said that countries such as Brazil, Colombia, and Guatemala show greater inequality than Uruguay or Argentina (IDB, 2024).

At the same time, it is essential to understand and address inequality as a multifaceted phenomenon, since income is not the only thing that is unevenly distributed. The region exhibits the highest level of land concentration in the world and shows deeply unequal indicators in terms of access to the internet, health, and education, to name a few dimensions.

Regarding internet penetration among the population, there are significant differences

between countries. When we look at the number of fixed broadband subscriptions per 100 inhabitants[1], data show that in 2023, although all countries in the region remain below the European Union average (39.0%), the gap with Uruguay is less than 7 percentage points (p.p.) (32.4%), while the gap with Jamaica exceeds 23 p.p. (15.8%) and with Honduras it widens even further surpassing 30 p.p. (4.4%). It is also worth noting that in 2023 Colombia's figure is close to the average for LAC (17.0% and 17.9%, respectively), and that the country shows a similar pattern to the region in the expansion of high-speed fixed internet penetration between 2007 and 2023.

Figure 1. High-speed fixed internet penetration, Latin American and Caribbean countries and world regions



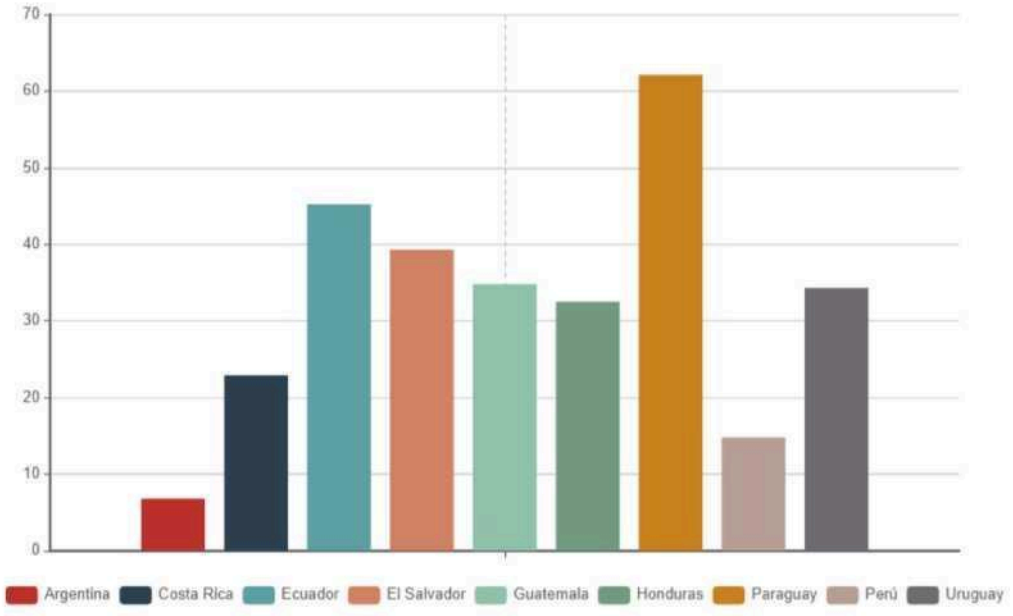
Source: Digital Development Observatory. CEPALSTAT - ECLAC - UNITED NATIONS.

Meanwhile, the connectivity gap between households with the highest (Q5) and lowest (Q1)[2] incomes varies across countries in the region. Among the countries for which this information is available for 2023, only two show gaps below 20 p.p. (Argentina: 6.8 p.p. and Peru: 14.8 p.p.). Five countries show gaps between 20 and 40 p.p. (Costa Rica: 22.9 p.p.; Honduras: 32.5 p.p.; Uruguay: 34.3 p.p.; Guatemala: 34.8 p.p.; El Salvador: 39.3 p.p.) and in two countries gaps are higher than 40 p.p. (Ecuador: 45.2 p.p. and Paraguay: 62.1 p.p.).

[1] Fixed broadband subscriptions refer to Internet subscriptions at download speeds equal to or greater than 256 kbit/s. They include cable modem, DSL, fiber optic, other fixed (wired) broadband connections, satellite broadband, and fixed terrestrial wireless broadband.

[2] The gap refers to the difference in internet access penetration between households in each income quintile, Q5 and Q1; since the values represent penetration rates, the resulting unit of measurement after subtraction is percentage points (p.p.).

Figure 2. Connectivity gap between households in the highest (Q5) and lowest (Q1) income quintiles, Latin American and Caribbean countries



Source: Digital Development Observatory. CEPALSTAT - ECLAC - UNITED NATIONS.

In this context, it is relevant to revisit the concept of intersectionality, which is highly useful for identifying and designing responses to the multiple forms of vulnerability that intersect within an individual's life trajectory[3]. Intersectionality reminds us that experiences of exclusion or differentiated access to digital education depend on the interaction of multiple factors: gender, ethnicity, migration status, mother tongue, rural or urban location, disability, sexual orientation, among others. For example: An Indigenous girl in a rural area does not face only a lack of technological infrastructure; she is also affected by language barriers, gender discrimination, and territorial dynamics of exclusion. Similarly, an Afro-descendant teenager living in a marginalized urban neighborhood may have access to a mobile device but lack a safe environment, support networks, or culturally relevant content that would allow him or her to sustain their educational trajectory.

This is why, in the field of Digital Educational Transformation, public policies and pedagogical practices are needed that take into account the intersection of inequalities and acknowledge the diversity of experiences—complementing state initiatives focused on the distribution of devices or the provision of connectivity. Intersectionality thus serves as an analytical and ethical framework that cautions against designing "universal" interventions which, by overlooking differences, may ultimately reproduce or even deepen existing gaps.

[3] The term "intersectionality" is attributed to Kimberlé Crenshaw, whose article "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics" (1989) argues that black women face simultaneous oppression based on both gender and race, and that these experiences cannot be reduced to the sum of gender-based and race-based discrimination. More information is available at: https://www.britannica.com/story/what-is-intersectionality

Educational digitalization in the region can only contribute to equity if it is taken with an intersectional approach: recognizing that educational trajectories are shaped by multiple layers of inequality and that solutions must respond to that complexity rather than a single dimension of exclusion.

The integration of digital technologies into education systems can offer an opportunity to close gaps, but it can also risk deepening them

Countries in LAC are still far from achieving universal access to inclusive, high-quality education that ensures meaningful learning and enables young people to shape self-determined life paths.

Regarding school attendance and **completion of compulsory education**, as of 2022, 14.3% of Latin American adolescents from households in the lowest 30% income bracket were not attending upper secondary school. In contrast, among adolescents from households in the highest 40% income bracket, this proportion was nearly half, at 7.9%. It is worth noting that in some countries, the percentage of adolescents from households in the lowest 30% income bracket not attending upper secondary school in 2022 exceeds 20%. (Colombia: 25.7%; Mexico: 26.3%; El Salvador: 29.1%; Honduras: 40.3%) (SITEAL, IIPE UNESCO - Base of Statistical Indicators).

Focusing on **educational achievements** and **access to meaningful learning**, the report *El aprendizaje no puede esperar: Lecciones para América Latina y el Caribe a partir de PISA 2022 (*IDB and World Bank, 2024) exposes the differences in learning among children from different social classes. The report indicates that 88% of the poorest children and 55% of the richest children performed poorly in mathematics in the 2022 PISA assessments. While low performance is also evident among wealthier students, the impact of social class on learning outcomes is clear.

In this context, **integrating digital technologies into education systems can help reduce gaps in access, retention, and performance; however, it also carries the risk of widening existing inequalities**. According to the Inter-American Development Bank (IDB), about 55% of schools in the region that participated in PISA 2022 reported a lack of access to—or poor quality of—digital resources (IDB and World Bank, 2024).

The inclusion of the digital dimension in the PISA 2025 assessments offers an opportunity to rethink what we understand by educational quality in the 21st century, recognizing access to technology as an essential component to ensure equity and social justice[4].

Digital transformation in education has gained increasing relevance, especially after the COVID-19 pandemic, which exposed deep inequalities in access to technology and digital infrastructure. This landscape has become more complex with the emergence of generative artificial intelligence in 2022, which brings new opportunities but also poses significant challenges for the region's education systems.

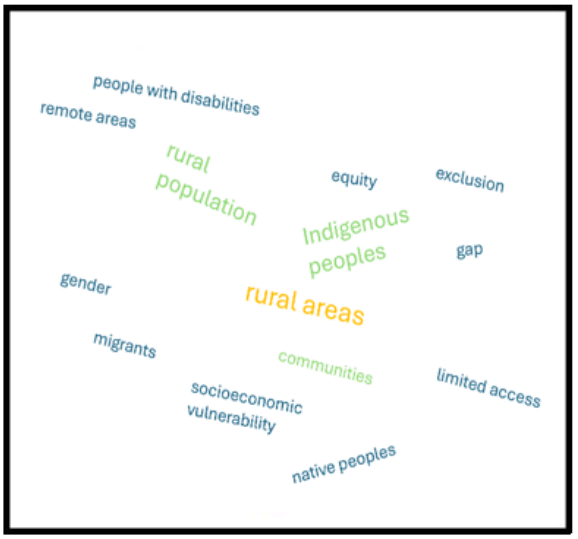
While progress must be acknowledged, major disparities persist, particularly affecting children and adolescents in situations of socioeconomic vulnerability, whose educational trajectories are shaped by intersecting inequalities. It is worth recalling that one of the

[4] PISA 2025 - Learn in the Digital World. For the first time, the assessment measures students' ability to use digital tools to explore systems, represent ideas, and solve problems using computational logic. https://www.oecd.org/en/topics/sub-issues/learning-in-the-digital-world/pisa-2025-learning-in-the-digital-world.html

objectives of the project Strengthening Local Capacities to Build a Sustainable and Impactful Digital Educational Transformation in LAC is to generate evidence on the current state of digital technology integration in education systems. As part of the actions to achieve this objective, Fundación Ceibal is conducting a regional diagnostic study focused on identifying needs, weaknesses, and strengths. Within this framework, various stakeholders[5] from 29 Latin American and Caribbean countries are completing a survey that measures the education system's level of readiness for digital transformation across nine pillars[6]. The first pillar of the survey, "Educational System Context"—which refers to the set of structural, policy, institutional, and cultural conditions within the education system that influence the potential to advance digital educational transformation—includes the following open-ended question: "Indicate whether technology integration programs and technological tools to support students at risk of dropping out have been implemented nationwide, or whether there are areas or groups where greater efforts should be concentrated." The responses reflect a high level of awareness of the region's social and territorial inequalities, with frequent references to:

- Rural students: the most affected by structural weaknesses.
- Students living in poverty: face difficulties in access, retention, and educational progression.
- Indigenous or Afro-descendant students: mentioned less frequently but identified as facing issues such as lack of curricular relevance or cultural barriers.
- Migrants or displaced persons present in border countries.

The following word cloud illustrates the recurrence of certain references to the most disadvantaged groups and territories, highlighting the persistence of structural inequalities that shape digital educational transformation processes in the region.



[5] The five stakeholder profiles consulted in each country are: 1. EDUCATION SYSTEM LEADER – GOVERNMENT ACTOR-; 2. PEDAGOGICAL LEADER – GOVERNMENT ACTOR- ; 3. TECHNOLOGY LEADER – GOVERNMENT ACTOR- ; 4. SCHOOL-LEVEL ACTOR IN BASIC EDUCATION / EDUCATIONAL COMMUNITY; 5.THIRD SECTOR / CIVIL SOCIETY / RESEARCHERS / UNIVERSITIES.

[6] This information will be analyzed by Fundación Ceibal and shared in April 2026 through a final public report. The nine pillars are: EDUCATION SYSTEM CONTEXT; PROBLEM IDENTIFICATION; DEFINITION OF SUCCESS; DEVICES; CONNECTIVITY; PLATFORMS; PROGRAMS; TEACHER TRAINING; DATA.

Word cloud extracted from https://ceibal-analytics.kan.com.ar/ October 2025.

To prevent the widening of existing gaps and to foster the creation of educational environments that provide development opportunities for all people in the region, it is urgent to promote research that offers concrete solutions for integrating digital technologies from an equity-based perspective.

Opportunities, tensions and challenges of Digital Educational Transformation (DET) in Latin America and the Caribbean

Building a comprehensive and context-sensitive vision of DET requires, first and foremost, alignment between education policies and national digital transformation strategies. It also calls for sustainable agreements that transcend changes in government (UNICEF – IIPE UNESCO, 2022, p. 8).

The integration of digital technologies in education offers multiple **opportunities**, including:

- fostering interactive and collaborative learning environments.
- enriching the educational experience of students and teachers.
- facilitating pedagogical continuity in times of emergency.
- creating communication and support networks among teachers, families, and students.
- promoting accessibility for students with disabilities.
- supporting the monitoring of educational trajectories through early warning tools.
- optimizing public management through administrative platforms.
- using tools such as georeferencing to improve equity in the distribution of resources.

However, Digital Educational Transformation also involves risks and tensions that must be addressed:

- The growing influence of private actors in key decisions (regarding devices, content, and platforms) can conflict with goals of equity and educational quality.
- Fragmented digital policies limit the impact of initiatives. For example, device distribution without pedagogical support can be counterproductive. As highlighted in the GEM Report 2023, in Peru, more than one million laptops were distributed without strategies for classroom integration, which did not translate into learning improvements (UNESCO, 2023, p. 7).
- Excessive or inappropriate use of ICT can have negative effects on learning and student well-being, as shown by various studies identifying links between intensive screen use and problems such as attention difficulties, anxiety, or social isolation.

Furthermore, according to the IDB (2021), Digital Educational Transformation must be approached as a **multidimensional challenge** that requires comprehensive development across at least four key dimensions:

1. Hardware: well-equipped classrooms, along with technical support, maintenance and updating of equipment.

2. Connectivity: access both at school and at home to ensure learning continuity.
3. Teacher skills: training and guidance to enable meaningful, technology-mediated pedagogical practice.
4. Digital content: curriculum-aligned, accessible, and relevant learning resources.

In search of studies, models, methodologies, and digital tools that strengthen the educational trajectories of socioeconomically vulnerable populations in Latin America and the Caribbean

The launch of this call for research projects represents an opportunity to generate evidence and develop studies, models, methodologies, and/or digital tools focused on one or more of the following areas:

➢ School management systems

The implementation of digital school management systems can help optimize administrative processes, ensure transparency in academic information, and facilitate data-driven decision-making. In contexts of high social and economic vulnerability, these tools enable closer monitoring of attendance, performance, and student retention, strengthening institutional capacity to coordinate timely responses that ensure continuous and equitable educational trajectories. A recent UNICEF report (2024) explicitly identifies the use of education information systems as a key strategy to guarantee coverage, retention, and learning achievement for children and adolescents in vulnerable situations. It is worth noting that smart school management systems support resource prioritization, vulnerability mapping, and interinstitutional coordination to provide comprehensive support that combines psychosocial assistance with academic reinforcement. When implemented with equity, transparency, and data protection criteria, school management systems can enable a shift from reactive interventions to proactive, evidence-based policies.

➢ Strategies to identify students at risk and ensure timely interventions

Digital technologies offer new possibilities for the early detection of signs of learning delay or school dropout through real-time data analysis. Designing digital strategies to identify at-risk students is key in Latin America and the Caribbean, where socioeconomic, territorial and cultural factors affect school continuity. Preventing school dropout requires prioritizing interventions grounded in reliable and timely data. Among the most widely promoted strategies is the implementation of Early Warning Systems, designed to identify students at risk of disengagement. These systems rely on the identification of specific indicators that anticipate or contribute to dropout and make it possible to deploy context-specific responses aimed at strengthening school continuity (Perusia and Cardini, 2021). A timely approach, supported by the use of digital technologies, makes it possible to implement interventions that break the cycle of exclusion and promote school retention.

➢ Strengthening learning outcomes

The use of interactive and adaptive digital resources can enrich teaching and learning processes and respond to the specific needs of students in vulnerable situations. These technologies make it possible to diversify materials, promote active learning, and facilitate access to high-quality content that might, otherwise, be out of reach. In this way,

strengthening learning through digital means becomes an essential component in ensuring more solid and continuous educational trajectories. The use of digital resources for learning activities supports personalized and interactive experiences that foster critical thinking and curiosity. While the opportunities offered by technology and the importance of developing digital skills are widely recognized, recent studies also warn that excessive use of these resources can lead to significant distractions and attention problems (Dirgha Raj Josh et al., 2025). Digital learning tools include websites, apps, online games, interactive simulations, and software used to teach and support students' learning and homework (Gallup, 2019). These resources are transforming traditional educational practices, fostering student engagement, and supporting the development of digital competencies essential for the 21st century. They offer new ways to access information, interact with materials, and connect with both peers and teachers (Dirgha Raj Josh et al., 2025).

➢ **Designing contextualized comprehensive support**

Support measures designed with a contextualized perspective have the potential to recognize the cultural, linguistic, and territorial diversity of LAC. For vulnerable populations, integrating technological tools that combine pedagogical, socioemotional, and community dimensions makes it possible to provide comprehensive support that goes beyond academic matters, addressing the social factors that affect educational continuity. In this context, the opportunities offered by digital technologies to coordinate support across traditionally fragmented sectors—such as education, health, and social protection—become particularly relevant, as they enable information sharing, service coordination, and the implementation of timely interventions (UNICEF, 2025). This potential is especially significant in contexts where structural inequalities limit access to basic services and increase the risk of educational and social exclusion. When the monitoring of educational trajectories is complemented by health and social protection systems, a more comprehensive approach becomes possible, where information on school attendance can be linked to indicators such as nutrition, vaccination, or participation in conditional cash transfer programs (UNESCO, 2020; IDB, 2023). Likewise, the design of support mechanisms must be contextualized to respond to the specific conditions of each territory. This involves not only adapting content to local languages and cultures but also ensuring the technological sustainability and relevance of solutions in communities with limited connectivity (Plaza de la Hoz et al., 2024; Gálvez & Revinova, 2025). In this way, digital technologies enable the creation of an integrated support infrastructure that connects education, health, and social protection, helping to reduce the socioeconomic gaps that affect children and adolescents in the region.

➢ **Use of AI to support educational trajectories**

Artificial intelligence (AI) can strengthen educational trajectories by providing personalized tutoring and recommendations tailored to each student's characteristics. In contexts of high vulnerability, these capabilities make it possible to optimize scarce resources and provide fairer and more effective forms of support. However, the use of AI requires ethical and pedagogical frameworks that prevent bias and ensure an inclusive, critical, and creative use of technology. The integration of AI systems allows for timely and personalized interventions. Machine learning models support the design of tailored approaches, such as targeted tutoring, alerts for support teams, and reinforcement trajectories. Such initiatives have been documented and recommended in recent reports analyzing the potential of AI to personalize support without replacing the teacher's role (Molina et al., 2024). In contexts of socioeconomic vulnerability—where barriers to

access, lack of infrastructure, and shortages of specialized teachers limit opportunities—AI-based platforms can deliver differentiated content according to each student's pace and needs (micro-lessons, automated diagnostic exercises, immediate feedback) and record progress to coordinate follow-up across schools, social services, and health systems. Regional analyses show that although the access gap remains a challenge, there are examples and frameworks that demonstrate how AI can serve as an amplifier of inclusion strategies when accompanied by investment in connectivity and teacher training (Rivas, 2025; IDB, 2025). For AI to play an inclusive role, it must be supported by ethical frameworks, data governance, and teacher training focused on technology-mediated pedagogical practices. Without these conditions—equitable connectivity, bias assessment tools, training, and community participation—the adoption of AI risks reproducing or deepening existing inequalities. This is why regional evidence and recommendations emphasize comprehensive approaches that combine technology, infrastructure investment, and public policies aimed at promoting equity (Molina et al., 2024).

➢ **Providing information to families to strengthen educational trajectories**

Digital technologies can enhance family participation in the educational process by creating accessible, transparent, and two-way communication channels. In populations facing vulnerability, where families encounter structural barriers to engaging in their children's schooling, the provision of clear and relevant information through digital means can strengthen shared educational responsibility and become a decisive factor for school continuity and success. An obstacle to school retention among children and adolescents in vulnerable situations is the lack of clear and timely communication between schools and families regarding issues such as attendance, academic performance, school requirements, or early signs of disengagement. Digital technologies can help close this gap by facilitating access for parents and caregivers to relevant information about their children's educational trajectories—through automated reports, text messages, school apps, or digital education management platforms. When parents receive regular updates on attendance, grades, delays, or challenges, they can act in time, collaborate with schools, and support their children in overcoming difficulties before they worsen. Recent studies show that simple interventions, such as text messages sent to families, have a positive impact on attendance, functioning as "educational nudges" (small prompts)[7]. A concrete example can be found in Uruguay, where an initiative focused on sending text messages to families about the importance of initial education showed that such reminders increased attendance (Ajzenman et al., 2022). Providing appropriate information not only improves regular school attendance but can also strengthen family participation and engagement in education.

In contexts of educational vulnerability, many families are unaware of expected educational standards or how to interpret the reports they receive, which limits their ability to support the learning process at home. Finally, for the information provided to effectively strengthen educational trajectories, such strategies must be designed with appropriate accessibility and frequency criteria. It is important that messages are delivered in understandable formats (language, clarity, educational level), through

[7] Nudging is a behavioral change strategy increasingly used in education to address challenges such as student attendance, teaching practices, parental engagement and caregivers. *Nudges* are conveyed through concise messages delivered at strategic decision-making moments to influence behavior toward desired outcomes. The essential purpose of a *nudge* is to encourage individuals to modify their behavior in response to a specific issue. More information is available at: https://edtechhub.org/evidence/learning-brief-series/nudging-for-behaviour-change-in-education/

communication channels suited to each context (SMS, apps, calls, simple platforms), and that the data shared is reliable and up to date. Only under these conditions can information provision function as a preventive and supportive tool.

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The areas presented reflect the wide range of opportunities that digital technologies offer to strengthen educational trajectories in contexts of vulnerability. The challenge for the projects supported under this call will be to harness the transformative potential of technology through an ethical, contextualized, and human-centered approach—ensuring that each innovation effectively contributes to guaranteeing the right to quality education for all. It is expected that the selected projects will generate evidence and scalable proposals for public policies across Latin America and the Caribbean.

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